Strong Zonal Winds in Triton's (and Pluto's?) Middle Atmosphere

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The central flash detected in the Triton stellar occultation lightcurve measured at the IRTF last year (Olkin *et al.*, submitted to *Icarus*; Elliot *et al.*, this conference) provides strong evidence that the atmosphere is distorted from a spherical shape. A second result from that occultation, namely that the atmospheric temperature profile is isothermal to adiabatic approximately 60–100km above the surface, suggests this region is dominated by strong mixing. Thermal winds provide a plausible mechanism for creating this mixing, and may partially account for the distorted shape of the atmosphere as well.

The dynamical regime of Triton's atmosphere is determined by the Rossby number, $R_0 = v/L\Omega$, where v is wind speed, L is the scale of the motion, and Ω is the angular velocity of Triton's rotation. $R_0 < 1$ implies that geostrophic balance governs atmospheric motions, while for $R_0 > 1$ cyclostrophic force balance pertains. Assuming a modest temperature gradient of 0.01K per degree of latitude, the thermal wind equations for both types of dynamics predict $R_0 >> 1$, so cyclostrophic balance is a better predictor of Triton's winds. Thermal cyclostrophic winds would result in an equatorial jet, were the subsolar latitude on Triton near the equator, much as is observed in Venus' atmosphere. Models predicting the strength and distribution of the circulation for the case of Triton will be presented and the possible relationship of this circulation to the occultation observations explored. These calculations are also essentially valid for Pluto, and may explain some observed and/or postulated features of that atmosphere as well. These speculations present a strong argument for vigorously persuing a predicted occultation of another star by Triton next summer.

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